

**First Results from RHIC:  
Silicon Drift Detector  
Accomplishments and Future Goals**

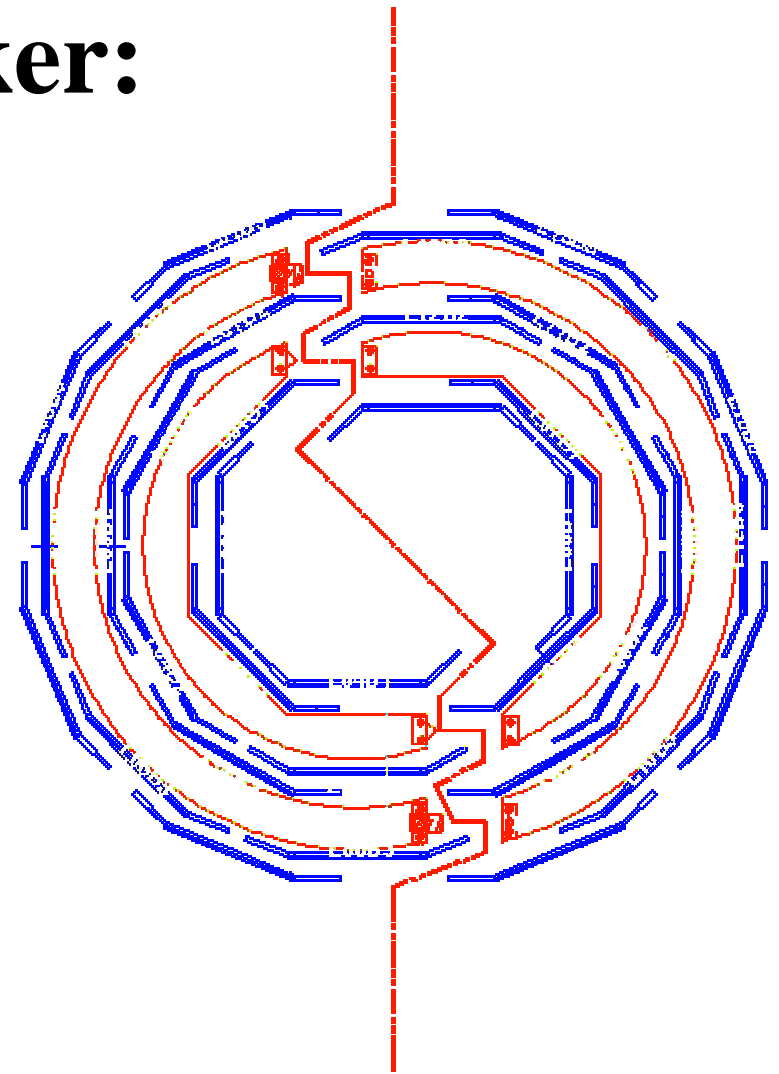
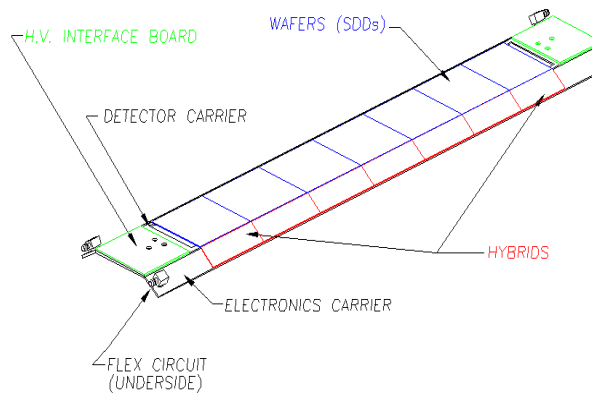
**Robert Willson**

**The Ohio State University**

**STAR Collaboration**

**October 7, 2000**

# A Silicon Vertex Tracker:

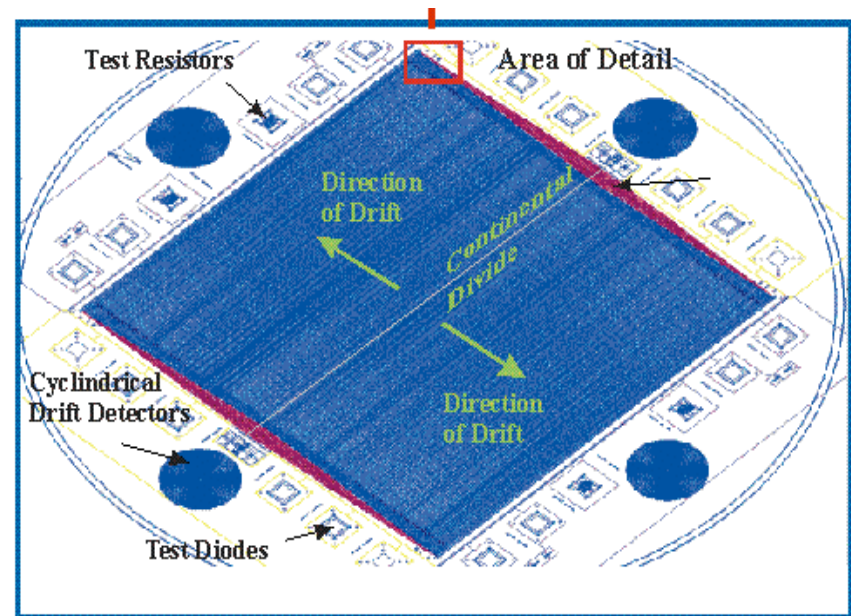
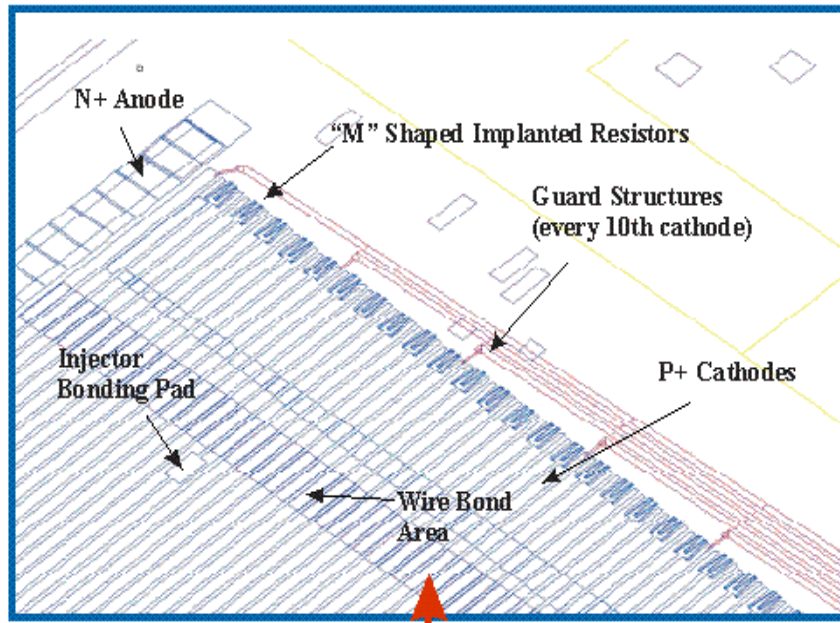


# SVT Characteristics

- Fine Pixel Resolution ( $20\mu\text{m}$ )
- Low noise ( $500 e^-$ , MIP =  $25000 e^-$ )
- Close proximity to interaction region allows reconstruction of strange hadrons
- Large Size Detectors
  - 6 cm X 6 cm
  - $0.7 \text{ m}^2$  Si

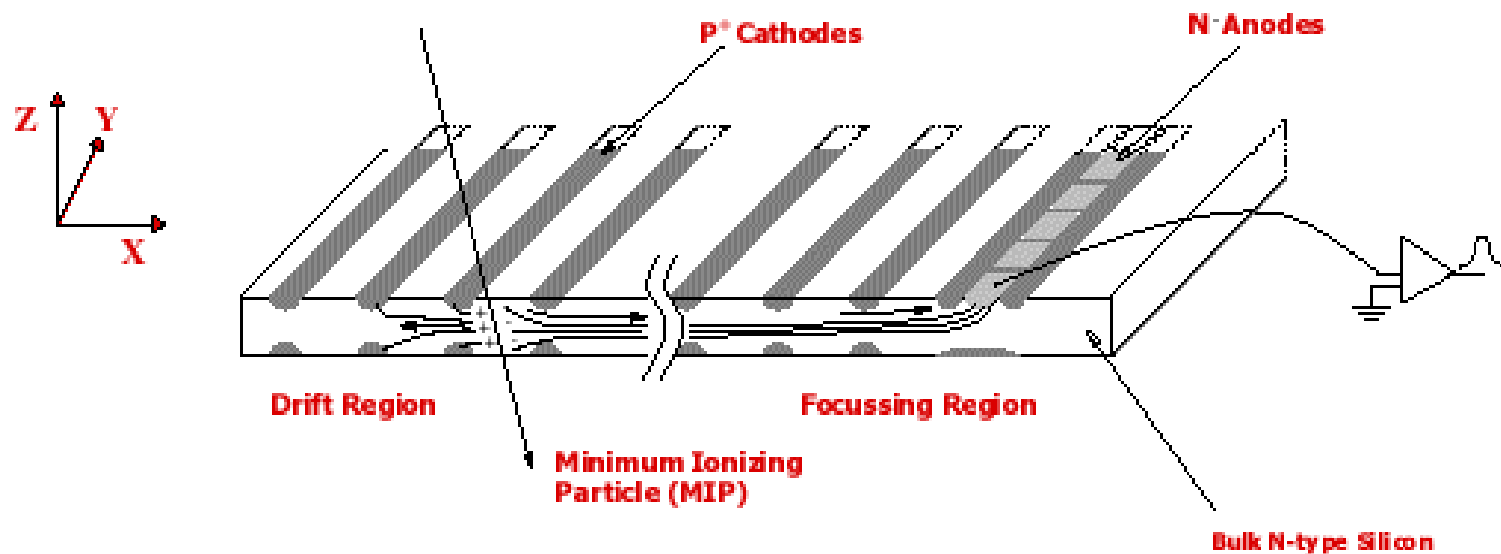
# Detector Description

- Ladders composed of 4" n-type silicon wafers

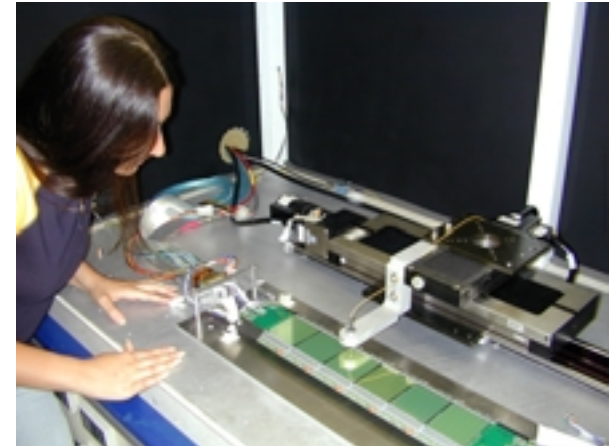


- p+ strips form cathodes, upon which high voltage is applied

- When a charged particle passes through the wafer, it creates electron/hole pairs in the depleted silicon.
- λ Voltage gradient across cathodes provides the force which moves electron cloud toward anode collectors.

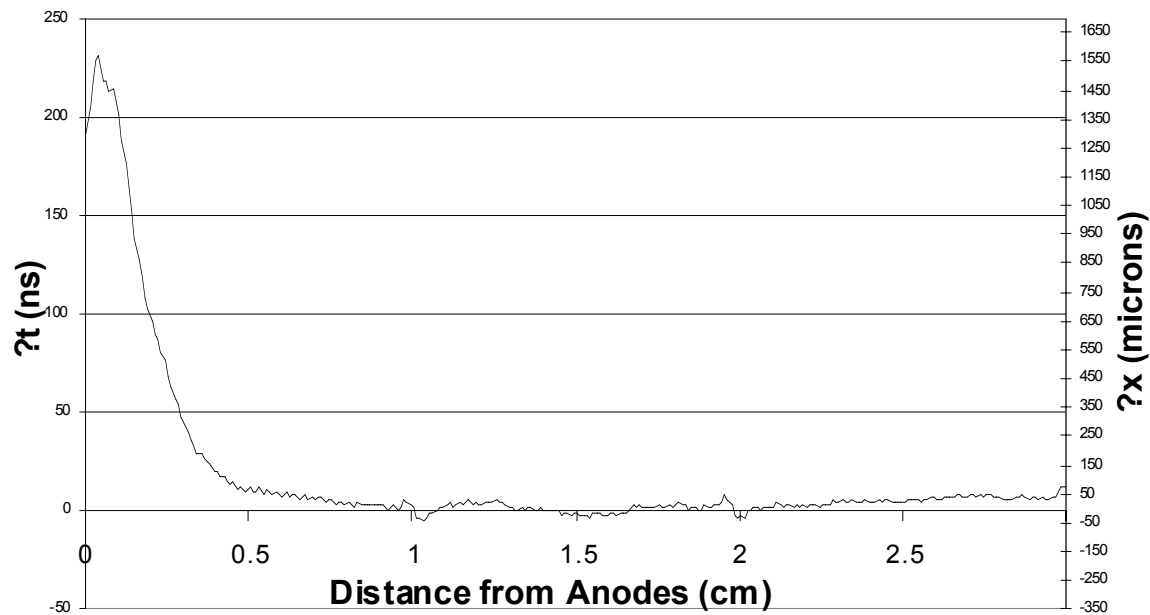


# Calibration of Drift Region

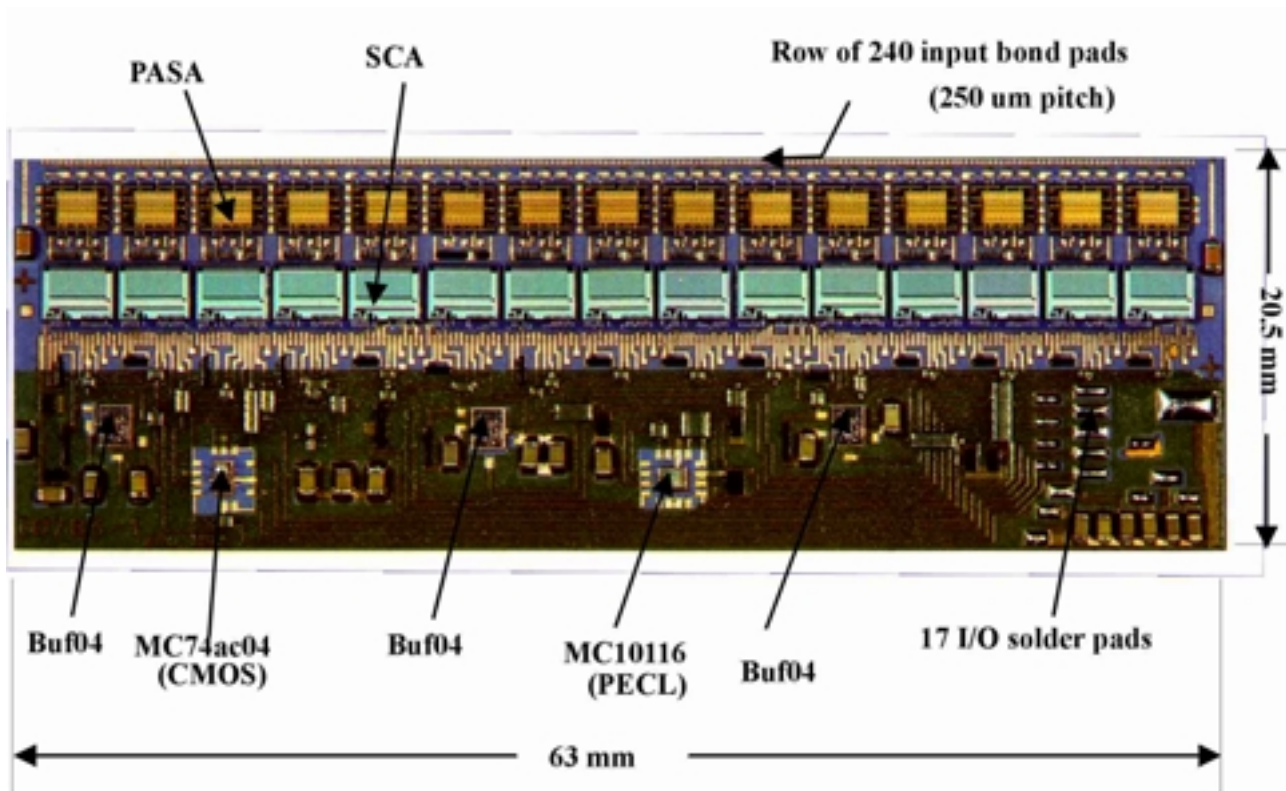


SVT Ladder Calibration Station

## Difference From Linear Fit



- Charge is collected at the anode and moved to a preamplifier shaper array (PASA), where the charge is converted to a voltage.
- The time distribution of the signal along an anode is stored in a capacitor array (SCA).
  - Anode gives x dimension, time for charge to move to anode gives y dimension.



- Properties of Si Wafers
  - Thickness: 280  $\mu\text{m}$
  - Resistivity: 3  $\text{k}\Omega\cdot\text{cm}$
  - Anode Spacing: 250  $\mu\text{m}$ 
    - $\lambda$  charge sharing allows for 20  $\mu\text{m}$  resolution
  - Cathode Spacing: 135  $\mu\text{m}$
- 1500 Volts applied through resistor chain to cathodes
  - $\Delta V/\Delta x$ : 500V/cm
  - Drift Velocity: 6.6  $\mu\text{m}/\text{ns}$
  - Drift Time: 4.5  $\mu\text{s}$



# Data Flow

128 channels stored in SCA for an event

240 anodes connect to a single hybrid

= 30720 pixels per half wafer

216 wafers used in SVT

= **13,271,040** pixels

read out through **103,680** anode channels

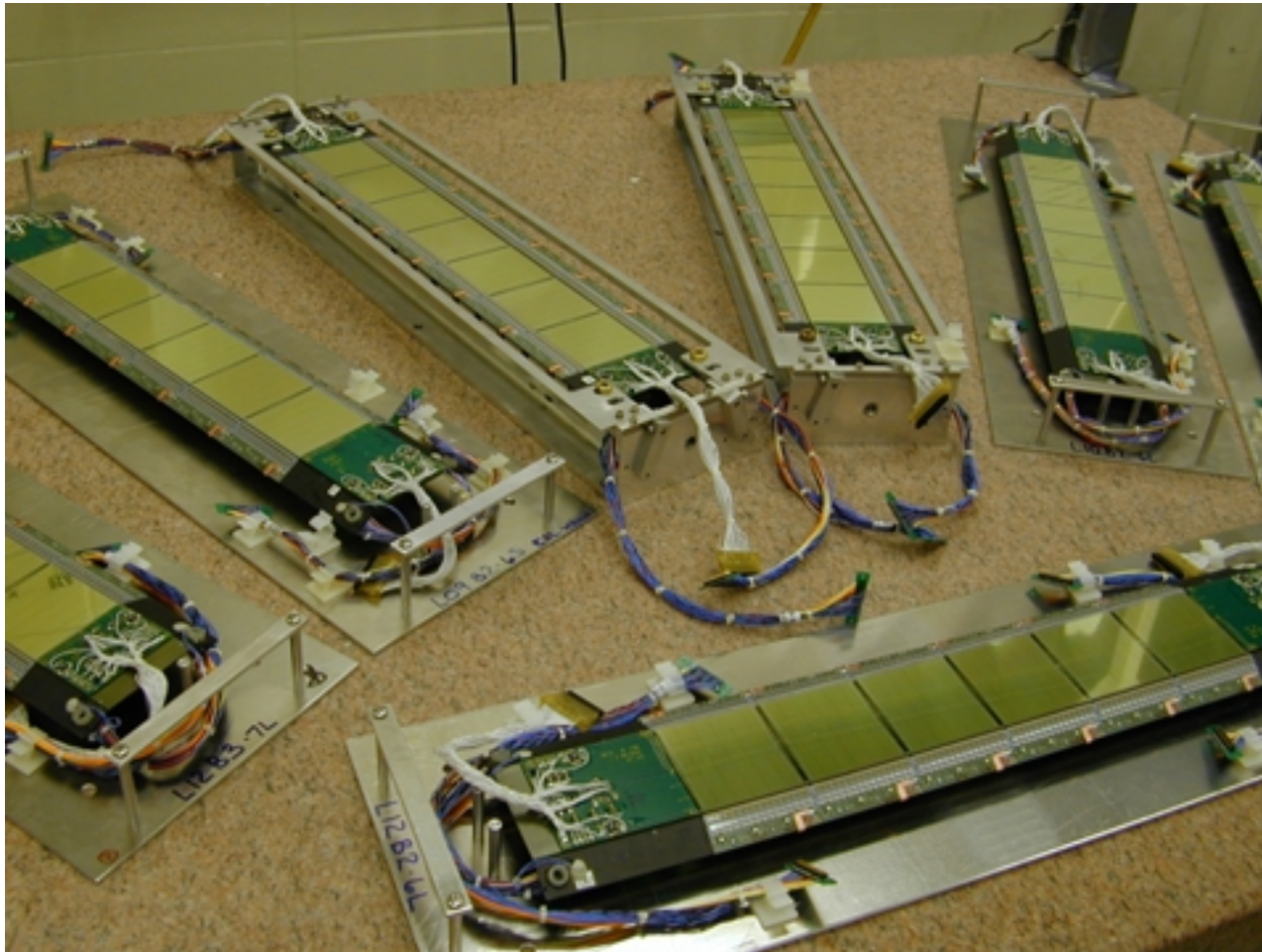
**1296** analog lines

**24** fiber optic drops

- Zero suppression at DAQ results in a total event size of 250KB

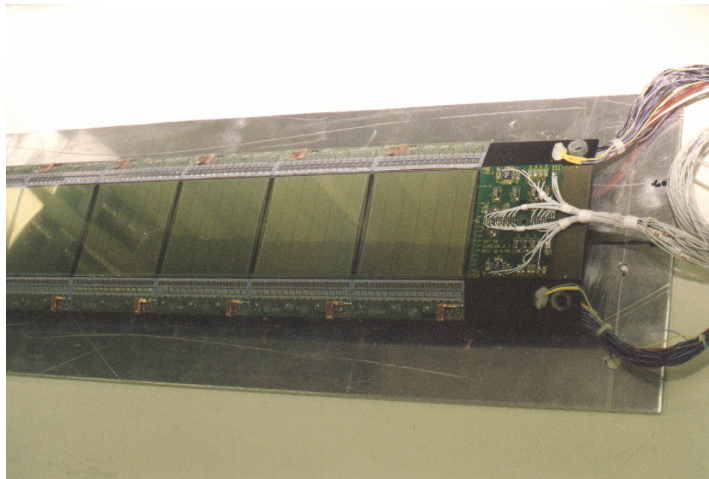
# Construction

- 36 ladders to be constructed for SVT, a total of 216 4" silicon wafers.

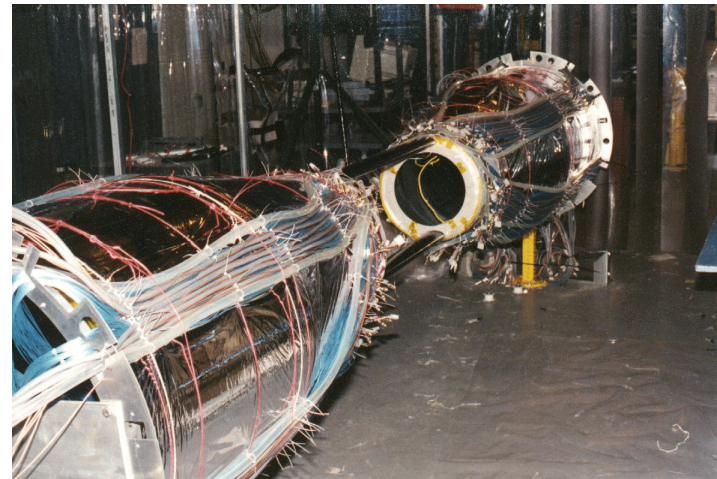


# Year 1 Ladder

- Seven wafer ladder placed 10 cm from vertex
- Allows for testing of RDO system and noise effects while in TPC
- Analysis of TPC results will provide information on detector calibration

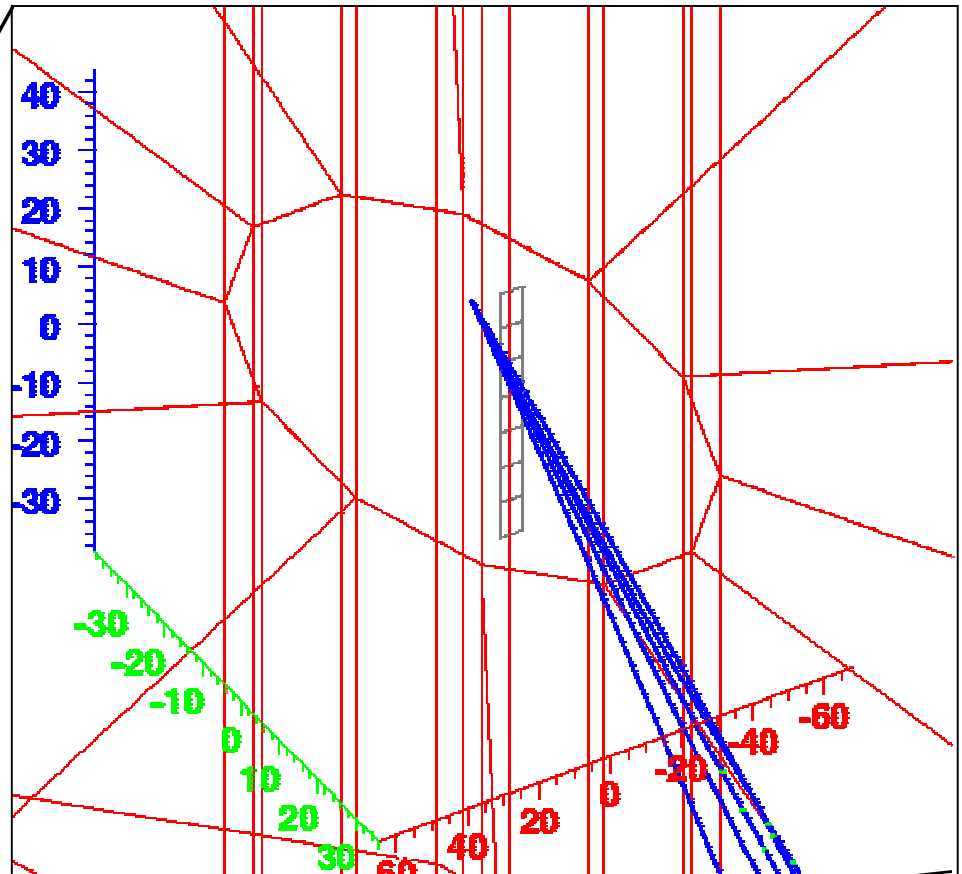
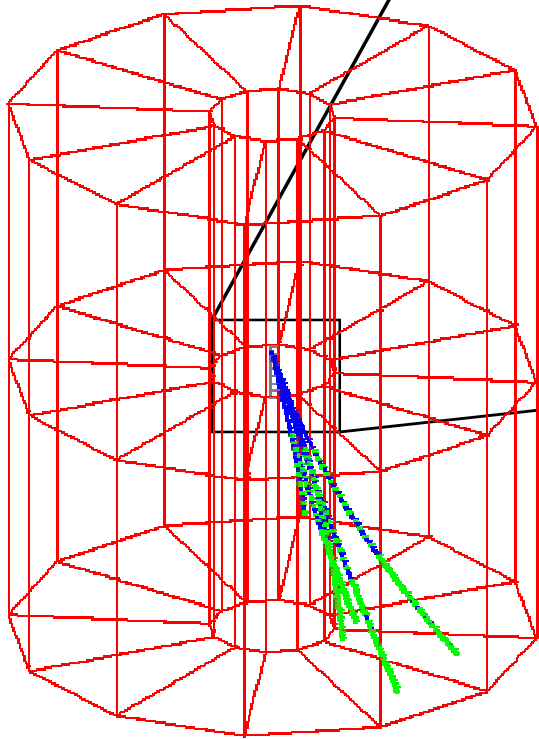


View of east side

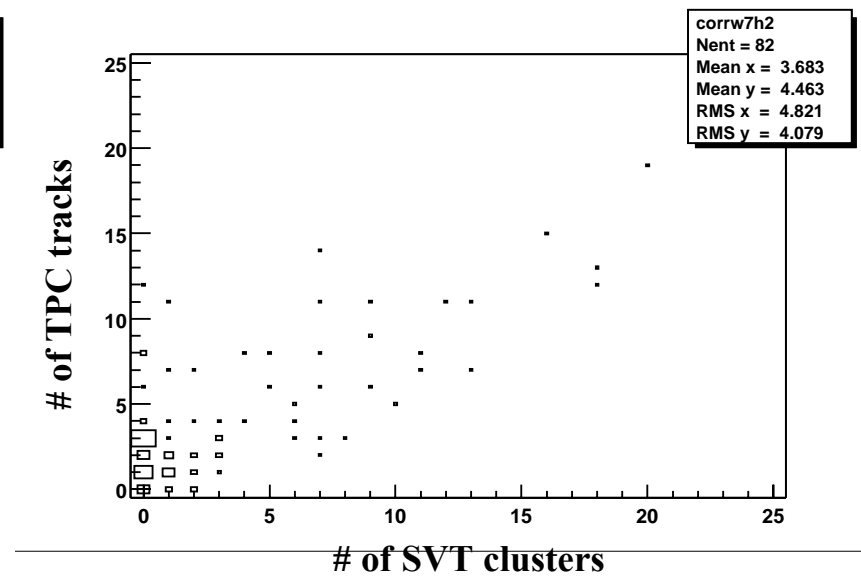
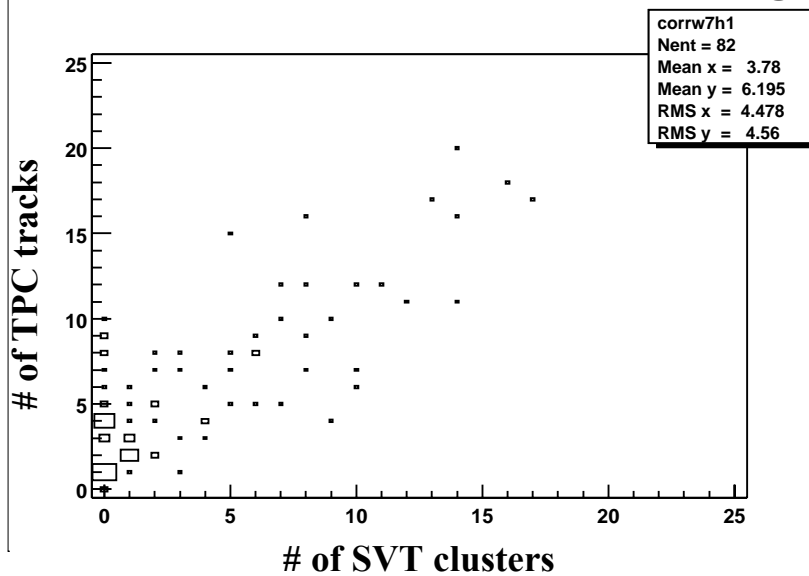


Cone for installation & beam pipe support

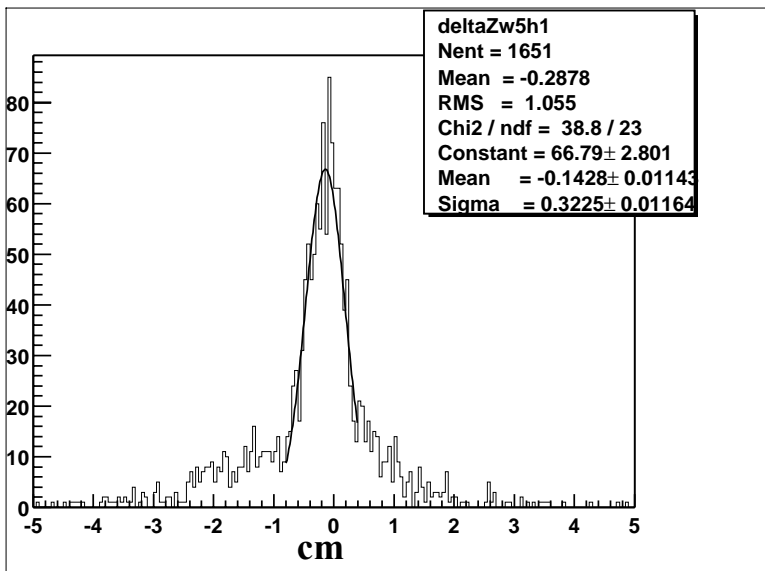
# TPC Track Projection to SVT Ladder



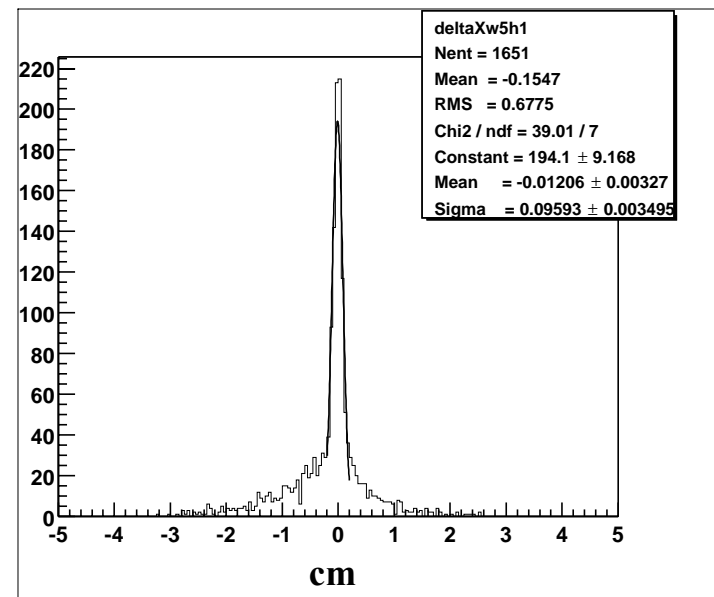
## Correlation of intersecting TPC tracks with SVT clusters



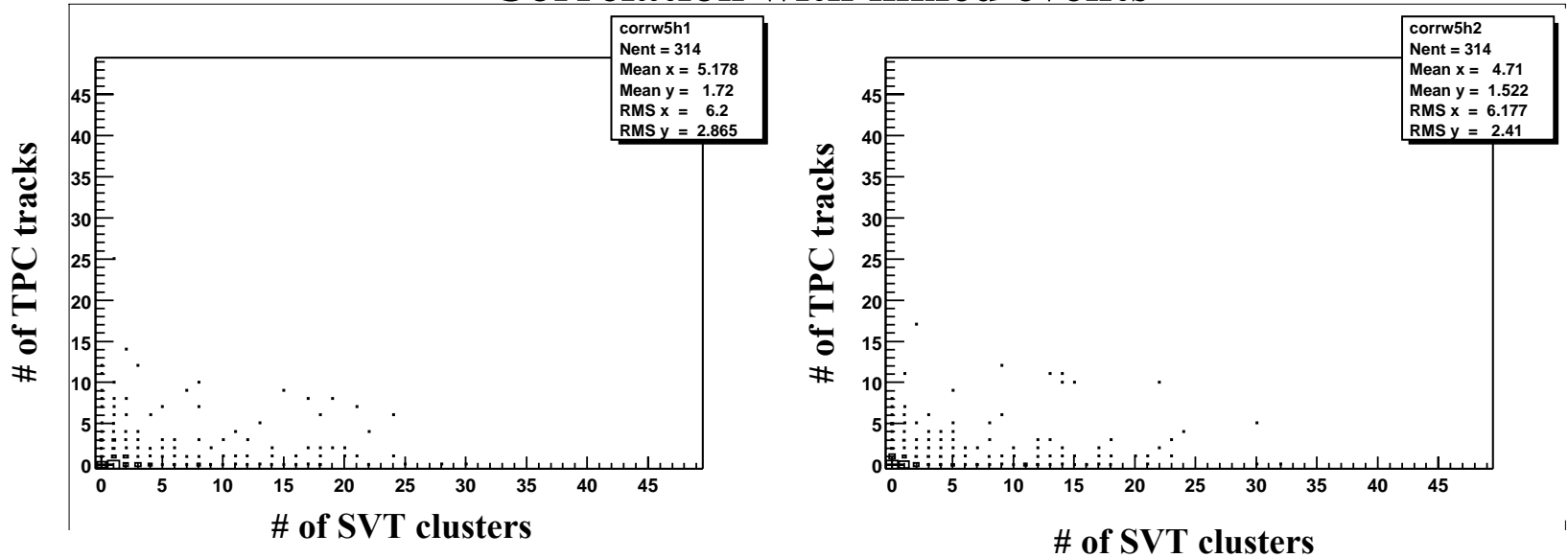
## Residuals of anode (Z) position of cluster with closest TPC track in R



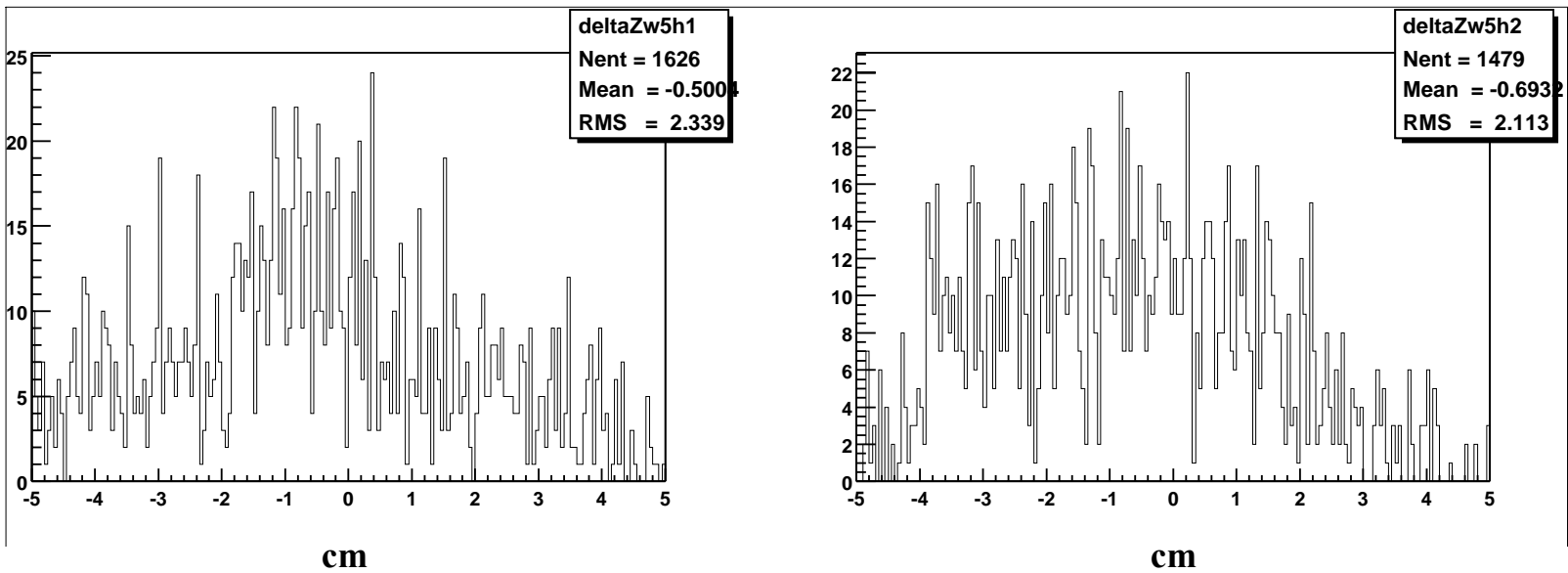
## Residuals of drift (X) position of cluster with closest TPC track in R



## Correlation with mixed events



## Residuals of drift position for mixed events



# Conclusions

- Proof of principle for SVT operation established
- TPC track correlation demonstrates correct operation of system
- With the inclusion of final SVT, physics of short-lived hadrons will be made possible with secondary vertex reconstruction